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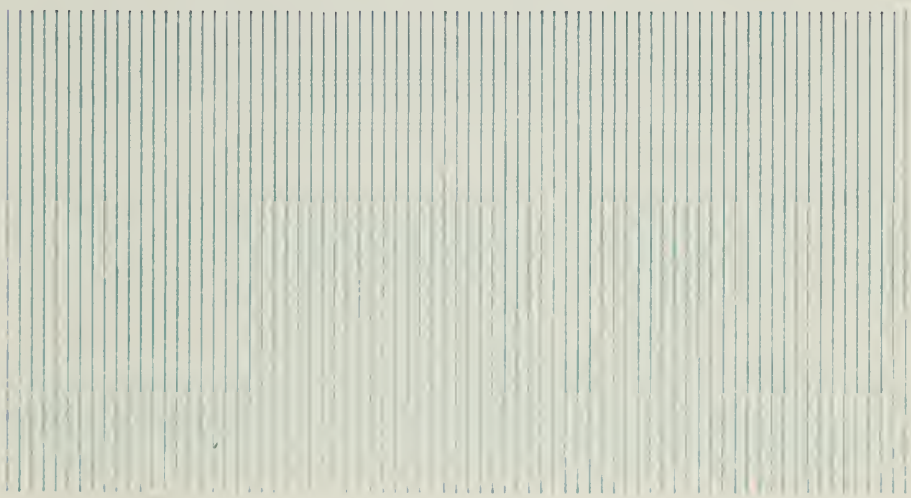
UNIVERSITY STANDARDS FOR SAFETY

UNIVERSITY OF ILLINOIS, 1964



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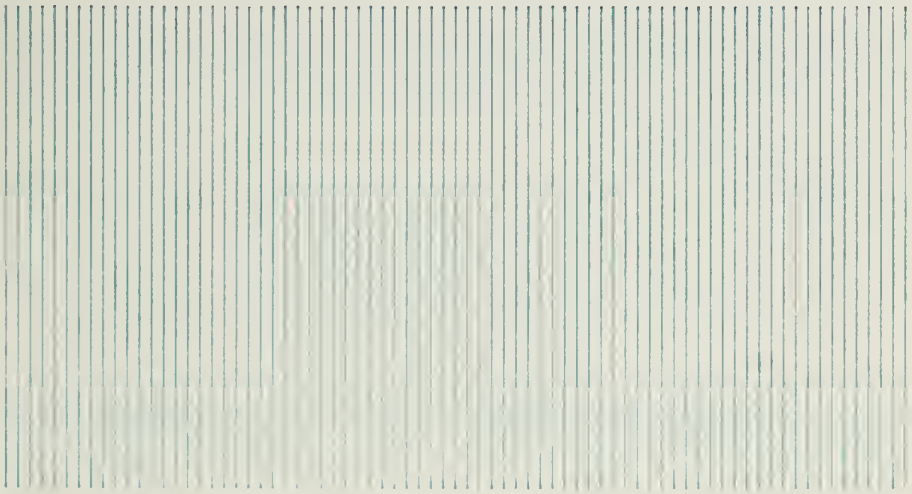

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PREFACE

The publication of University policies, regulations, and practices defined to promote safety is a reminder that safety is the concern of everyone. The advice and counsel of safety specialists are essential but the best possible safety record can be achieved only through the interest and cooperation of the entire staff.

Furthermore, it is not enough for us to repeat "Be careful." Optimum safety conditions are the result of good planning, including the design of buildings, the specifications of equipment, and the organization of operations. Continuing supervision is also essential. All kinds of facilities and programs are involved, academic and nonacademic.

I hope that this publication, sponsored by the Safety and Fire Prevention Committee, will be both a helpful reminder and a useful guide.

DAVID D. HENRY
PRESIDENT

May 28, 1964

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FOREWORD

Administrative decisions relative to safety at the University of Illinois are frequently made by following the best available national standard, such as the National Fire Codes of the National Fire Protection Association, the various publications of the Underwriters' Laboratories, the National Board of Fire Underwriters, the National Safety Council, and other such standards. However, there has been a need also for the internal development of standards to meet specific needs of the University. This publication places these standards under one cover for the first time and shows the nature of the University's sense of responsibility in the fields of safety and fire safety. Date of adoption or publication of a standard and the origin are indicated in footnotes with the designation SFP (for Safety and Fire Prevention Committee) or OSC (Office of the Safety Coordinator).

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PART I

ALL-UNIVERSITY SAFETY STANDARDS

I-1 UNIVERSITY SAFETY POLICY*

The University places above all other considerations the safety and well-being of its students, faculty, and staff. It is the first duty of instructors, supervisors, and all other persons in authority to provide for safety in the environment and operations under their control.

Safety policy within the University is developed by the Safety and Fire Prevention Committee, the Safety Coordinator, and various interested administrators. The University subscribes to recognized national standards of safety and fire protection, such as are published in materials of the American Standards Association, the National Safety Council, the National Fire Protection Association, the Underwriters' Laboratories, and other standard-making bodies.

Other safety standards are developed specifically for the University and are written into official University publications, such as Physical Plant Building Standards, the Business Policy and Procedures Manual, and the Code on Student Affairs.

* 9-28-60 (Official Notice No. 57)
All-University Policy

I-2 COLOR CODE*

The University recognizes American Standards Association Code Z53.1-1953 as the best authority for good practice in marking of physical hazards and the identification of certain equipment.

As defined in the code, these are the basic meanings of color usage:

Color	*Designation*
Red	Fire Apparatus — Stop — Danger
Orange	Dangerous part of machines or energized equipment
Yellow	Marks physical hazards and designates caution
Green	Designates "Safety" for bulletin boards, gas masks, first aid kits, safety deluge showers
Blue	To warn against starting, use of, or movement of equipment under repair or being worked upon
Purple	Ionizing radiation exposure present
Black and white combination	Traffic and housekeeping markings

NOTE: Color coding is considered highly desirable. The main intent of this policy statement, however, is not to demand it in shops and laboratories, but merely to recognize a standard color code wherever color coding is used. The complete ASA code has more complete descriptions of the exact colors to be used.

* 10-14-59 SFP
All-University Policy

I-3 DANGEROUS MATERIALS*

The University recognizes that a primary responsibility of persons in authority is the protection of staff members, academic colleagues, students, employees, and the general public from the hazards of the University environment. This responsibility is of particular importance in the control of the hazards of materials which are intrinsically dangerous or injurious to health. Materials in these categories include those which are explosive, flammable, radioactive, infectious, or in some way toxic to persons.

The dangerous and harmful qualities of any material to be used must be evaluated by the department head, supervisor, chief investigator or supervisor of research, purchasing officer, or whoever introduces the material, and suitable control measures set up, including safe disposal procedures.

Education and instruction of persons in the specific hazards of dangerous or toxic materials is most important; it is not to be assumed that employees, staff members, or students are familiar with these hazards and will protect themselves.

Proper labeling of containers of hazardous and toxic substances is required by law (Illinois Revised Statutes, Part J, Health and Safety Act), and the labeling procedure should be extended to storage containers used in departments other than the original shipping container. Storage of unlabeled materials is costly and dangerous.

Label in use at Champaign-Urbana.

CARBON DISULFIDE

DANGER!
EXTREMELY FLAMMABLE
HIGHLY VOLATILE

Keep away from fire, sparks or heated surfaces.
Store in cool place and keep container closed.
Use only with adequate ventilation.
Avoid breathing vapor.
Avoid contact with skin and eyes.

POISON

FIRST AID PROCEDURE

Inhaled — remove to fresh air, artificial respiration if necessary. Call or take to (if unconscious) Poison Center.

Swallowed — cause vomiting by placing finger in back of throat and/or drinking quantities of warm salt (NaCl, fairly concentrated) water.

UNIVERSITY OF ILLINOIS
GENERAL CHEMICAL STORES
55 NOYES LAB.

* 4-25-62 SFP;
revised 10-15-64
All-University Policy

I-4 ELECTRICAL HAZARDS*

Safety to Life

Fatal electrical shock occurs frequently in the use of ungrounded portable tools. This is particularly true of portable drills. As the tool deteriorates with use, the metal of the frame or housing becomes energized by breakdown of the insulation or by bridging from motor parts to frame by metallic particles and dirt. Unless the frame of such a tool is grounded so as to carry off this unwanted current, the worker using the tool is in danger of electrocution the moment he first uses it when he himself is well grounded, as he might be by resting a hand or an arm against a water pipe, or against well grounded equipment, or even by standing on a concrete floor.

To guard against this kind of accident and other electrical accidents, University Departments will follow procedures recommended in the National Electrical Code, including the following:

PORTABLE ELECTRIC TOOLS

All portable electric tools shall have the exposed metal of the frame connected to a ground wire, and the end of the flexible electric cord shall be equipped with a three-pronged polarized plug. Portable power tools which cannot be purchased with the three-wire plug already installed will be modified before being issued for use on the job.

GROUNDING

Exposed metal parts of all other electrical equipment located within reach of a person who can make contact with any grounded surface or object must be grounded to prevent the possibility of fatal electric shock.

ELECTRIC EXTENSION CORDS

All electric extension cords for 110-120-volt service to portable power tools shall be of standard heavy duty three-wire cord, one wire of which shall be a grounding conductor, and shall be equipped with a three-pronged grounding-type plug.

PORTABLE HAND LIGHTS

(1) In grounded areas: For work on the ground or in pits, tanks, boilers, water pressure filters, and other areas which are well grounded, low-voltage insulating transformers shall be used to supply current for portable extension hand lights. The transformers and 110-volt supply wires must not be taken inside boilers or

* Revised 10-15-64 SFP
All-University Policy

similar equipment. Maximum voltage at the job site shall be 32 volts, and 6 or 12 volts is preferred.

(2) In explosive atmospheres: Where portable hand lights are required for use in the possible presence of explosive vapors, an explosion-proof lamp must be used.

OUTLETS (RECEPTACLES)

Convenience outlets shall be provided as required to permit the use of three-pronged polarized plugs on portable electric tools and extension cords.

Fire Prevention; Good Electrical Practices

(1) Extension cords are not acceptable as permanent extensions of electrical service in buildings. They are permissible for such light load appliances as desk lamps and small floor fans provided that:

a. The cord is UL listed, not longer than six feet, and in good repair.

b. The cord is entirely visible and does not pass through wall openings, doorways, partitions, or under rugs.

c. The cord is not spliced, tied in knots, wrapped around metal fixtures, or draped over pipes.

(2) Heavy load appliances, including refrigerators, space heaters, coffee makers, hot plates, etc., shall be connected directly to permanent outlets by the service cord attached to the appliance, if any. Light duty types of extension cord are not permissible.

(3) Fuses of appropriate capacity are installed by University electricians in the various electrical circuits in buildings to protect against fire which otherwise would result from destruction of a defective appliance or wiring through overheating. It is not permissible to replace a burned-out 15-ampere fuse with a fuse of higher amperage rating. Physical Plant routing office* should be notified of a blown fuse and asked to replace it. A blown fuse usually indicates that a given circuit has been overloaded beyond the rated capacity of the wiring and that the load should be reduced or redistributed to other circuits, or that the source of overload be determined by a qualified electrician.

Responsibility of Persons in Authority

It shall be the responsibility of supervisors, foremen, faculty members and research supervisors and other persons in authority to see that these procedures are carried out in areas and operations under their control.

* At Medical Center, call Ext. 7511; at Champaign-Urbana call 333-0340; at Chicago Circle, call 2835.

I-5 EMERGENCY VEHICLES*

The movement of emergency vehicles in response to requests for assistance to injured persons, to persons who require resuscitation, to extinguish a fire and to rescue persons endangered by a fire, always involves some risk to normal traffic, to persons riding emergency vehicles, and to persons requesting assistance. If the emergency vehicle proceeds at the same speed as normal traffic, the assistance to be furnished by the emergency team may arrive too late, whereas if the emergency vehicle proceeds too rapidly and becomes involved in a traffic accident, it may not arrive at all and may cause additional casualties. The driver of the emergency vehicle is at a distinct disadvantage in trying to resolve this problem, because usually he does not have sufficient facts to evaluate the urgency needed until after he arrives at the scene.

The public expects emergency vehicles to proceed promptly to scenes of emergencies. However, this cannot be accomplished if the emergency vehicle is brought to a complete stop at each stop sign, and at each and every traffic light when faced with a red light. The law provides, therefore, that the speed limit is waived and other cars are required to yield the right-of-way to the driver of the emergency vehicle responding to an emergency call.

University policy on the safe operation of emergency vehicles is as follows:

Emergency vehicles when responding to an emergency call shall proceed to the scene of the emergency as promptly as practical and safe. The siren and red warning light shall be used to warn other vehicles to yield the right-of-way. Emergency vehicles may proceed through stop signs or against red traffic light signals providing:

(1) The siren and red warning light are used to give ample warning to conflicting traffic.

(2) The vehicle can be brought to a stop if conflicting traffic fails to yield the right-of-way.

The driver of an emergency vehicle is not relieved from the duty to drive with due regard for the safety of all persons using the street nor is such a driver protected from the consequences of a reckless disregard for the safety of others.

* 2-22-61 SFP
All-University Policy

I-6 EYE PROTECTION*

(1) The University recognizes the need for eye protection for certain jobs and areas of work.

(2) Eye hazards (flying objects or particles, dirt, dust, and wind, molten metal, gases, fumes, smoke, liquids, reflected light or glare, injurious radiant energy) and the special eye protection required are outlined in the American Standards publication ASA Z2.1-1959, American Standard Safety Code for Head, Eye and Respiratory Protection, approved November 27, 1959. All University employees exposed to such hazards in their duties or work areas must be provided with appropriate eye protection. Department heads may designate jobs requiring eye protection which do not happen to be listed on the schedule but which have similar hazards.

(3) The University will pay as department expense, on the recommendation of the department, the entire cost of plano** safety glasses or spectacles to be fitted to any individual daily or frequently exposed to occupational eye hazards. Any such glasses must meet ASA standards for both lenses and frames, and must bear the required marks of the manufacturer on both.

(4) Persons designated by the department to be fitted with safety glasses and who require corrective glasses will be provided with glasses ground to their prescription.*** The employee will pay only the cost of the refraction charge (if any). The University will pay all other costs, including the manufacture of the special lens required by the prescription. There would be no charge to the employee whose prescription is current and who does not require a new examination. Any such glasses must meet ASA standards for both lenses and frames, and must bear the required marks of the manufacturer on both.

(5) Where the nature of the eye hazard requires other types of eye protection, such as cover-all goggles, face shields, etc., these special types will be provided.

(6) The use of the eye protection provided on jobs requiring eye protection will be considered a condition of employment.

(7) The University will pay a maximum of $3.50 for frames for safety glasses. Such frames must meet federal specifications. Written permission of the department head must be obtained for purchase of frames not meeting federal specifications.

* 9-23-59 SFP; revised 10-15-64
** Plain, no correction required
*** Referred to in ASA Code Z2.1-1959 as "Prescription safety spectacles."
All-University Policy

(8) Workmen performing occasional work requiring eye protection, and not provided with safety glasses under this policy, must be provided with appropriate eye protection for the duration of the job requiring it and will be required to make use of such eye protection.

(9) Safety glasses purchased under this policy will remain the property of the University.

(10) The cost of repairs or replacement of damaged safety glasses is paid by the University if the individual has provided reasonable care for them.

(11) The responsibility for carrying out the eye protection policy rests with the employee's supervisors.

(12) A purchase order for safety glasses will be considered authorization by the department for an individual to be fitted.

(13) Employees of the University having only one eye or having good vision in only one eye should be fitted with safety glasses to protect their remaining sight, regardless of the nature of their classification or duties, under the same procedures as described above for workers exposed to constant eye hazards, and at University expense.

(14) Lenses for safety glasses must conform to ASA standard for thickness, and shall not be less than 3.0 millimeters at the thinnest point, whether of glass or plastic (Ref.: par. 6.3.3.1, ASA Z2.1-1959).

Interpretation of this policy can be obtained from the Safety Coordinator, Urbana, or the Safety Officer, Chicago. Questions of purchasing details may be referred to the appropriate Purchasing Division.

*Eye Protection in Athletics**

All persons subject to University direction or control, or who are permitted to make use of University facilities for participation in sports and athletics, shall be required to forego the wearing of ordinary glasses while engaged in those sports where there is a high degree of risk of breakage of the glasses by contact. The participant may protect against the risk of injury through breakage of ordinary glasses by removing them while participating in such sports, by the wearing of safety glasses, or in some instances by the wearing of protective eye guards to prevent damage to the glasses.** This policy will be considered mandatory with regard to baseball, touch football, soccer, squash, football, basketball, ice hockey, handball, and other sports where there is a similar exposure to persons wearing glasses.

* 4-20-60 SFP
** Contact lenses are also acceptable.
All-University Policy

I-7 FIRE SAFETY*

The University follows such fire protection standards as are promulgated in

The National Fire Codes of the National Fire Protection Association (NFPA) including the National Electrical Code, etc.

Fire Prevention Code, National Board of Fire Underwriters (NBFU)

National Building Code, National Board of Fire Underwriters (NBFU)

Standards and periodical listings, Underwriters' Laboratories

Chicago Building Code

These codes are used in the design and construction of new buildings and planning of alterations in existing buildings, and for many details of operation of the University, such as

Flammable liquids handling, storage, and disposal
Purchase of electrical equipment, power tools, etc.
Specifications on building materials for new construction
Design of lightning protection for buildings
Fire prevention procedures, rules, etc.
Specifications for first aid fire fighting equipment

Fire Safety responsibilities of the Safety Coordinator, Urbana, and the Safety Officer, Chicago, include participation in the planning of fire safety of buildings and the development of safe practices in both academic and nonacademic operations in accordance with recognized fire safety principles.

Fire protection problems specifically in the areas of fire fighting, water supply, provision and maintenance of fire extinguishers in University buildings, installation, repair and maintenance of fire alarms, fire detection systems and automatic sprinkler fire protection systems are referrable to Physical Plant officials, as follows: the Superintendent of Sanitation and Safety at Urbana and the Superintendent of Fire Prevention and Safety at Chicago.

* Revised 10-15-64 SFP
All-University Policy

I-8 FIRST AID*

The following conclusions were derived from a study by the Health Service and the Safety Coordinator concerning the desirability of continuing the use of first aid cabinets in University buildings:

(1) The first aid cabinet commonly becomes an unsatisfactory substitute for and a deterrent to obtaining physician care.

(2) Since Health Service physicians are available to provide medical attention and treatment for all on-the-job injuries, most of the first aid cabinets in University buildings will be removed.

(3) (Chicago only) At any time when medical attention for an emergency is not available at the appropriate health service, emergency services at Research and Educational Hospitals will be used, in accordance with procedures which have been set up at each Chicago campus.

(4) (Champaign-Urbana only) Supplies at Champaign-Urbana may be obtained from the General Chemical Storeroom, 55 Noyes Laboratory, at the expense of the department using these supplies.

(5) **Any department which has extraordinary need for first aid supplies may make application to the appropriate Director of Health Services for authorization to maintain an approved cabinet. Cabinets are to be stocked only with the following approved supplies:

First Aid Cabinet Supplies

(1) Hexachlorophene liquid soap — plastic container, 4 oz.
(2) Sterile gauze pads, 2″ x 2″; 3″ x 3″ — 12 each
(3) 2″ gauze bandage — 2 rolls
(4) ½″ tape, metal spool and cover
(5) 1″ band-aids in hinged metal box
(6) Neomycin Ointment, ½ oz. tube
(7) Tincture of Zephiran, 2 oz.
(8) Cotton-tipped applicators, short, single end
(9) Elastic bandage, 2″ x 5½ yd.
(10) Plastic Airway (for mouth-to-mouth artificial respiration)
(11) Unidote

* Revised 10-15-64 SFP
** Does not apply at Medical Center
All-University Policy

*First Aid Directions**

FOR BLEEDING

Apply a bundle of 2″ x 2″ gauze squares at a point that will stop the bleeding by pressure. Maintain pressure by applying the elastic bandage.

FOR BURNS

Apply dry sterile gauze to the burned area, then bandage.

CUTS AND ABRASIONS

Wash with antiseptic liquid soap and paint with Tincture of Zephiran or dress with sterile gauze to which antibiotic ointment has been applied.

ARTIFICIAL RESPIRATION

Draw the tongue of the unconscious person forward with a handkerchief and insert the airway behind the tongue until the plastic plate lies against the lips. Then apply mouth-to-mouth breathing.

NOTE: These directions assume that the patient will be seen as soon as possible by a physician.

* Does not apply at Medical Center

I-9 MOTOR VEHICLES*

The use of a University motor vehicle from the University's motor pool involves a special obligation for safe operation of the vehicle on the highway; this is brought out in Section XII, Business Policy and Procedure Manual, in the following passage: "In individual instances of accidents to University vehicles where serious lack of judgment or negligence of safe driving practice has been apparent and has resulted in serious property loss to the University or personal injury to the University operator or to other persons, the University reserves the right to suspend the employee's privilege of operating University vehicles."

* 4-21-59 SFP
All-University Policy

I-10 REFRIGERATORS*

Refrigerators and other enclosed equipment to be used in laboratories and in other locations where there is any possibility that flammable substances will be stored therein should be so designed in the construction or altered mechanically that the risk of internal explosion is eliminated. Such equipment already installed in laboratories and subject to the explosion hazard should be altered and made safe by the removal of lights, switches, and any other sparking mechanism to the outside of the box.

Laboratory centrifuges, deep freezer cabinets, and other closed equipment must be similarly protected. Walk-in refrigerator chests should be protected by removal to a safe location of all spark-producing lights, switches, wiring, and apparatus.

Refrigerators and any other equipment to be used in rooms where flammable vapors may accumulate should be further safeguarded so that the unit will not ignite such vapors.

All enclosed laboratory equipment subject to explosion should bear on the door or lid the appropriate University of Illinois safety office label specifying that the unit has been safeguarded against explosion or that it is not safe and no flammable solvents or materials should be stored therein. The label should be placed on the face of the door within 12 inches of the handle.

——WARNING——
EXPLOSION HAZARD

Do not use or store volatile solvents, chemicals, or explosive gases in open or sealed containers in this unit. It has not been explosion-proofed.

UNIVERSITY OF ILLINOIS
OFFICE OF THE SAFETY COORDINATOR

This unit is APPROVED for use with volatile solvents, chemicals, or gases.

UNIVERSITY OF ILLINOIS
OFFICE OF THE SAFETY COORDINATOR

Text of red (warning) and green (approved) labels in use at Champaign-Urbana.

* 5-22-63 SFP
All-University Policy

I-11 PIPING IDENTIFICATION*

The University recognizes ASA Code A13.1-1956 as the best authority for good practice in identifying the contents of piping systems. Meanings of colors and specifications of lettering are shown below:

Key to Classification of Predominant Colors	*Color*	*Color of Letters for Legends*
F Fire Protection	red	white
D Dangerous	yellow	black
S Safe	green	black
P Protective	blue	white

Outside Diameter of Pipe Covering (inches)	*Width of Color Band (inches)*	*Size of Legend Letters (inches)*
¾ to 1¼	8	½
1½ to 2	8	¾
2½ to 6	12	1¼
8 to 10	24	2½
over 10	32	3½

NOTE: The intent of this policy is to recognize the desirability of uniform color coding of piping and the attendant use of pressure sensitive labels for the same purpose. It is not intended to make color identification of piping mandatory in shops and laboratories. It is also recognized that variations from the code have been necessary in power plant operations, where a considerable number of color symbols are required.

* 5-27-59 SFP
All-University Policy

LIBRARY
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

I-12 CORRIDORS*

The need for maximum use of available space has resulted in requests for use of parts of corridors for departmental equipment.

Placing of equipment in corridors is not feasible except where corridor space is unusually ample, where the population in the building is very light, where no special fire or accident hazard is created, where recognized standards are not violated, and where foot traffic will not be impeded.

Corridors in buildings are not to be considered as spaces available to departments for expansion except with the express permission of the Director, Central Office on the Use of Space, Urbana, or the Vice-President, Medical Center, or the Vice-President, Chicago Circle.

* SFP 12-2-63; revised 10-15-64
All-University Policy

I-13 SAFETY SHOES*

The protection with special footwear of the feet of persons whose work exposes them to more than the ordinary hazard of foot injury is recognized as desirable and worthy of support by the University. As in industry, where the purchases of safety work shoes meeting ASA minimum standards are aided by a subsidy paid by the employer, the University will, at the request of authorized supervisors and department heads, reimburse any employee or faculty member 30 per cent of the cost of such shoes up to a maximum subsidy of $5.00.

This subsidy must be budgeted in department funds, and there will be no general fund set up to finance it. It may be made available as often as necessary to meet the demands of normal wear or damage from on-the-job accidents.

To obtain the subsidy for an employee who has purchased safety shoes, the department will send to the Purchasing Division a miscellaneous voucher together with the vendor's receipt or invoice indicating that the shoes have been paid for. Reimbursement will then be made directly to the person who purchased the shoes.

* SFP 4-21-64
All-University Policy

I-14 FIRE DOORS*

The preservation from destruction by fire of University buildings, along with costly equipment, rare collections and research in progress may depend on properly maintained fire doors. Lives of persons may also depend on such doors. In spite of this, it is common to find that self-closing doors installed for fire protection have been blocked or wedged in the open position as a personal convenience, or to improve a local ventilation problem.

It is the responsibility of all staff members to assist in avoiding the wedging or blocking of fire doors in buildings.

* SFP 4-22-59 (Official Notice No. 45); revised May 1964
All-University Policy

I-15 SMOKING REGULATIONS*

Smoking in University buildings is permitted in certain areas where "smoking permitted" notices are posted. It is prohibited in other areas for one or more of the following reasons: (1) To reduce the danger of fire; (2) To prevent annoyance to non-smokers; (3) To prevent damage to floors and furnishings which inevitably go with smoking. Revised regulations became effective January 1, 1963. Enforcement of the regulations is a matter of academic discipline in many "no smoking" situations and should be carried out in the same way as any other matter of discipline relating to the areas concerned.

(1) Smoking is permitted in offices, seminar rooms, lounges, and certain toilets and corridors when ash trays or urns are present to receive cigarette butts and other discarded smoking materials. **Discard of such materials on the floors or in wastebaskets is a violation of smoking regulations.**

a. Members of the staff who wish to smoke in their offices must *not* discard any smoking materials in wastepaper baskets or on the floors.

b. By means of a letter to the Executive Vice-President and Provost, deans and directors may request that these regulations be modified:

(i) In order to meet special conditions in areas under their control.

(ii) In order to carry out safely programs for which they are responsible.

(2) Smoking is prohibited at all times in classrooms, lecture rooms, teaching laboratories, theatres, warehouses, attics, storage areas, museums, elevators, library reading rooms and stacks, gymnasiums, shop and service areas where woodworking is in process, any area where volatile liquids are stored, used, or dispensed, posted areas, and any other areas where receptacles for discarding smoking materials are not available.

(3) A notice entitled "Smoking Regulations in University Buildings" shall be posted in all University buildings in the interior corridor or lobby at all entrances.

(4) Receptacles will be placed in corridors and in other designated public areas where smoking is permitted.

* 10-31-62 (Official Notice No. 71); revised May 1964
All-University Policy

PART II

CHAMPAIGN-URBANA SAFETY STANDARDS

II-1 BUILDING STANDARDS

The Building Standards of the Physical Plant Department (Urbana) form an important part of the University safety standards in that they prescribe certain codes and standards* to be followed by independent contractors in performing work for the University. Codes specified as mandatory standards under University contracts in the Building Standards include:

American Standard Safety Code for Elevators, Dumbwaiters, and Escalators, A.17.1, 1955
National Electrical Code, N.F.P.A.
National Board of Fire Underwriters, Standards
Chicago Building Code
Champaign and Urbana codes
Illinois codes
Building Construction Safety Ordinance (Ordinance 145) of Champaign

In addition, these standards include numerous more specific references to safety as related to specifications for details of construction.

NOTE: This whole standard applies to Champaign-Urbana campus construction. Separate standards are applied in Chicago operations.

* Ref.: P. 102, Building Standards; 2-1-61
Champaign-Urbana Policy

II-2 CHRISTMAS TREES*

(1) Any tree up to 4 feet tall may be displayed indoors where it does not tend to obstruct an exit or corridor and follows the standard precautions as follows:

a. Make a fresh cut diagonally at the base of the tree.

b. Set it in water or wet sand and keep adding water to the container as rapidly as it is absorbed by the tree.

c. Use tree lights in good repair and bearing UL symbol.

d. Keep tree away from radiators, steam pipes, and other sources of heat.

e. Avoid smoking, use of candlelight, and other open flame hazards.

f. Observe the same precautions for cut tree branches as for whole trees.

(2) Any tree over 4 feet high displayed indoors must be either

a. so treated with fire retardant flocking or other treatment that it would not burn readily or

b. a fresh cut tree not over 7 feet tall, cut not earlier than one week before the date it is to be set up indoors, and maintained with the standard precautions described above.

(3) Trees displayed indoors must remain indoors not longer than 14 days, regardless of size or treatment.

(4) All trees displayed indoors in student residence buildings should be removed from the building before it is vacated for the holidays.

(5) These restrictions do not apply to trees displayed outdoors.

* Revised 11-26-62 OSC
Champaign-Urbana Policy

II-3 CONSTRUCTION OPERATIONS OF INDEPENDENT CONTRACTORS*

A standard requirement of the University of Illinois specifications for new construction is that the contractor comply with provisions of Ordinance No. 145, Building Construction Safety Ordinance, adopted February 16, 1960, by the City of Champaign, Illinois, for construction at Champaign-Urbana. This measure was adopted as a minimum standard in safe work practices in construction. The complete text of the standard follows:

Section I	Drinking Water
Section II	First Aid Kits
Section III	Personal Protective Apparel, Clothing, and Safety Equipment
Section IV	Harmful Substances
Section V	Temporary Lighting and Electrical Wiring
Section VI	Materials Storage
Section VII	Tools and Equipment
Section VIII	Runways, Ramps, Platforms, Scaffolds, and Ladders
Section IX	Excavations
Section X	Toilet Facilities
Section XI	Removal of Rubbish

SECTION I — DRINKING WATER

A. Drinking water shall be supplied from sources approved by federal, state, or local health authorities and shall be dispensed by means which prevent contamination between source and the consumer.

NOTE: This standard was adopted not primorily far University wark operations, but far those of contractars, and with particular regard far the need far such protective measures os the sharing of trenches. For canstruction sofety in University aperatians, safety standards af the Natianal Safety Cauncil and other stondords ore used.

* Revised 5-1-62 SFP
Champaign-Urbana Policy

SECTION II — FIRST AID KITS

A. One first aid kit will be required on each project.

B. One kit will be required for each 25 employees.

C. The first aid kit shall contain the following items:

1 pkg. band-aids	1 pkg. 2″ gauze bandage
1 pkg. adhesive tape	1 pkg. 4″ gauze bandage
1 pkg. cotton	1 bottle iodine or merthiolate
1 pkg. burn ointment	1 pkg. ammonia inhalant
1 pkg. tourniquet	

D. The telephone number of the nearest ambulance service shall be prominently displayed on the lid of the first aid kit.

SECTION III — PERSONAL PROTECTIVE APPAREL, CLOTHING, AND SAFETY EQUIPMENT

A. Safety goggles having safety type lenses and screens for side protection (or face masks and helmets) shall be required for all personnel performing operations subjecting the eyes or head to dust and/or flying particles.

B. Electric and gas welding and cutting shall require face masks, shields, or helmets providing protection from all angles of direct exposure, and lenses of an appropriate shade.

C. "Hard hats" shall be worn by all personnel working in areas endangered by objects falling from above.

SECTION IV — HARMFUL SUBSTANCES

A. All dusts, mists, fumes, gases, or other atmospheric impurities in areas where personnel are employed, and in such quantities as are determined to be harmful to the health of such employees, shall be brought within safe limits by elimination, ventilation, or filtration.

B. Heating devices or melting kettles shall be placed on a level, firm foundation and protected against traffic and accidental tipping.

C. Burners or heaters using liquid fuel shall be shut down while refueling.

SECTION V — TEMPORARY LIGHTING AND ELECTRICAL WIRING

A. Adequate illumination shall be maintained during working hours in all work areas and passage ways. Additional lighting shall be provided around machines as necessary.

B. Temporary branch circuits wiring for single phase service shall consist of three (3) wires: a hot wire, a neutral wire, and a ground wire.

C. Single-phase power tools shall be provided with three (3) wire conductors, one of which shall be permanently identified by a green color for grounding purposes only. The four conductors shall comprise the core of a single rubber cord.

D. Receptacles to which power tools are connected shall be a polarized twist lock type.

E. Temporary services shall be installed and connected only by authorized and qualified personnel, and shall be of adequate capacity.

F. Disconnect switches on temporary wiring shall be provided with locks capable of being locked in an "off" position to prevent switching on while repairs are being made.

G. No work shall be done around or near underground or overhead primary lines carrying over 480 volts until the local power company has been notified and has approved adequate safety precautions.

SECTION VI — MATERIALS STORAGE

A. All material shall be stacked, blocked, interlocked, and limited in height so that it is stable and otherwise secured against sliding or collapse.

SECTION VII — TOOLS AND EQUIPMENT

A. Hand tools and portable power tools shall be maintained in an adequate state of repair for safe use and shall be used only for the purpose designed.

B. Heavy equipment shall be maintained in safe operating condition.

C. All operators of heavy equipment shall have an annual physical examination to determine that they have no deficiencies of sight or hearing or that they are not subject to epilepsy, heart or similar ailments which would be detrimental to safe operation of equipment. The operator shall carry a letter signed by the doctor performing the examination.

SECTION VIII — RUNWAYS, RAMPS, PLATFORMS, SCAFFOLDS, AND LADDERS

A. Scaffolds, platforms, or temporary floors shall be provided for all work except that which can be done safely from the ground, ladders, or other substantial footing.

B. Stairs, ladders, or other safe means of access shall be provided to all work areas.

C. All scaffolds or working platforms shall be securely fastened to the building or structure or braced and guyed to prevent sway.

D. Lumber used in the construction of ramps, runways, platforms, scaffolds,

and temporary floors shall be of good quality, reasonably straight grained, free of shakes, checks, splits, cross grains, unsound knots, or knots in groups.

E. Planking used on runways, platforms, ramps, or scaffolds shall be supported or braced to prevent excessive spring or deflection and secured to prevent loosening, tipping, or displacement.

F. Runways, ramps, platforms, and scaffolds more than 6 feet in height shall be equipped with guard rails of 36 to 42 inches in height and toeboards of not less than 6 inches in height.

G. During construction all openings in floors and roofs, such as stairwells, shaftways, and pits, shall be provided with an enclosure guard securely anchored in the opening.

H. All component parts of swinging scaffolds, platforms, boatswain's chairs, and scaffold machines shall be inspected daily by the supervisor of the work and tested as frequently as necessary to insure that minimum safety factors are maintained. (Test by raising working surface 1 foot above ground and load with two times maximum weight to be carried.)

I. All ladders shall be of sufficient length and shall be so placed that workmen can reach the uppermost point at which work is to be performed without stretching or assuming a hazardous position.

J. Broken or damaged ladders shall be removed from service immediately and repaired or destroyed.

K. Fixed ladders shall be secured by top, bottom, or sufficient intermediate fastening to hold them rigidly in place.

L. Provisions for landings at the top of all fixed ladders shall be made by the extension of side rails, hand holds, or other suitable means to a minimum of 42 inches above the landing.

M. All scaffolds erected on fill or backfill shall be placed on mud sills adequate to prevent tipping in the event of earth movement.

SECTION IX — EXCAVATIONS

A. Excavations, if over 5 feet in depth, unless in solid rock, hard shale, hard pan, cemented sand and gravel, or other similar materials, shall be either shored, sheeted and braced, or sloped to the angle of repose. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation. Sheeting, sheet piling, bracing, shoring trench boxes, and other similar methods of protection shall be based on calculation of pressures exerted by and the condition and nature of the materials to be retained, including surcharge imparted to the sides of the trench by equipment and stored materials.

B. Excavated or other material shall not be stored nearer than 4 feet from the edge of any excavation and shall be so stored and retained as to prevent its falling or sliding back into the excavation and to prevent excessive pressure from the sides of the excavation.

C. Temporary guardrails or barricades and red lights or torches, maintained from sunset to sunup, shall be placed at all excavations which are exposed to paths, walkways, sidewalks, driveways, or thoroughfares.*

SECTION X — TOILET FACILITIES

A. All new work or major remodeling work shall be provided with a toilet. The temporary toilet shall be enclosed and weatherproof and flyproof and kept in a sanitary condition at all times. As soon as conditions of the work will allow, the temporary toilet shall be located within the building.

SECTION XI — REMOVAL OF RUBBISH

A. Rubbish, debris, or discarded building material shall be removed as fast as it accumulates, keeping the building and premises clean during progress of construction.

* University standards also require an audible clicker type barricade flasher for the protection of the blind.

II-4 EXPLOSIVES*

(1) Standard safety procedures for the storage, handling, and use of explosives will be followed in compliance with the Illinois House Bill No. 451, approved July 12, 1939, "Regulations on Explosives." For any procedure not contained in House Bill No. 451, the most recent edition of DuPont's *Blaster's Handbook* will be considered as a safety manual for these operations.

House Bill 450, Section 5, will be interpreted to mean that no blasting caps, detonating caps, fulminating caps, or detonators will be stored in any magazine with other types of explosives. The three available magazines will be separately assigned to blasting caps, dynamite, and other equipment incidental to the blasting operations, and storage of the three classes of material shall be kept separate.

(2) The State Geological Survey will have the primary responsibility for the storage, maintenance, and use of the magazines for storage of explosives.

(3) University police and the Safety Coordinator's office will be notified when explosives have been placed in the magazines, and the police will take particular note of this in making the security rounds of the South Farm to guard against vandalism and theft of the explosives stored there.

(4) Small amounts of explosives will be stored, commensurate with actual needs of research projects planned and under execution, and a project will not be considered completed until leftover explosives have been properly and safely disposed of.

(5) An inventory of explosives kept and used at the South Farm magazines shall be deposited with the Safety Coordinator, and changes in the inventory shall be recorded periodically.

* 12-9-59 SFP; revised 10-15-64
Champaign-Urbana Policy

PART III

INFORMATION BULLETINS

III-1 ACETYLENE*

Mixtures of acetylene in air between the limits of 2.6 per cent and 80 per cent are explosive.** In this respect it is somewhat more dangerous than gasoline vapors, which are explosive in the much more limited range of 1.4 per cent to 7.6 per cent.

It should be remembered in storing cylinders that acetylene is a fuel gas. It ignites at 650° F., and cylinders must be stored away from radiators, fires, stoves, and other sources of heat. The fusible safety plugs which protect the cylinder from excessive temperatures melt at about the temperature of boiling water and release explosive acetylene.

Cylinders should always be stored with the valve end up. They should not be laid horizontal for storage or when in use.

When opening the valve give it not more than one and one half turns, then leave the T-wrench in position to close the valve promptly in case of an emergency. When opening the valve, stand away from the front of the gauge and regulator faces.

Do not use the recessed top of the tank for the storage of tools or other equipment.

Acetylene cylinders are constructed according to I.C.C. regulation 8 or 8 AL. They contain about 300 cu. ft. of dissolved acetylene under pressure of 250 psi at 70° F. Acetylene cylinders are not simply hollow containers filled with gas, but are completely filled with an approved porous material impregnated with acetone, the acetylene solvent. Since acetylene is highly soluble in acetone at cylinder filling pressure, large quantities of acetylene can be stored in comparatively small cylinders.

* 3-16-60 OSC

** *Accident Prevention Manual for Industrial Operations,* 4th Ed., 1959, National Safety Council

III-2 COMPRESSED GAS*

An explosion of a cylinder of CO_2 gas in a soft drink dispensing machine in an industrial plant killed one person and injured ten others. The probable causes assigned the explosion were "fatigue effect due to filling and emptying, and internal corrosion." While such defects cannot usually be found by visual inspection of the cylinders, they may be detected readily through preventive maintenance in a hydrostatic testing procedure such as is demanded for such cylinders under the Interstate Commerce Commission Rules.

Hydrostatic testing takes special equipment and consists of applying an internal hydrostatic pressure while the cylinder is submerged in a water jacket. Pressure is applied equal to 5/3 of the service pressure and held for at least 30 seconds. If the permanent expansion of the cylinder exceeds 10 per cent of the total expansion, the cylinder is condemned. If the cylinder passes the test, the date is stamped in the metal close to the I.C.C. stamping on the cylinder. A properly maintained cylinder bears markings resembling the following:

I.C.C./3A/1800/W.K. & Co./H 91503BF/7-46/6-51/5-56

The **I.C.C. 3A 1800** refers to the specific I.C.C. test procedure followed in construction of the cylinder. **1800** indicates service pressure. The letter **"H"** identifies an accredited I.C.C. inspection laboratory. **W.K. & Co.** denotes the manufacturer and **7-46** is the date of manufacture. Subsequent dates are dates of hydrostatic tests.

To obtain greater safety in the procurement and use of compressed gases, the Purchasing Division places on all purchase orders issued for cylinders the following stipulation:

Compressed gas cylinders delivered on this order shall comply with all I.C.C. regulations and the University of Illinois will refuse delivery of cylinders bearing test dates more than five years prior to the date of delivery.

Departments receiving compressed gas will necessarily be responsible for checking of cylinders for compliance with this policy. Arrangements for the return to suppliers of any old cylinders not bearing proper test dates should be made through the Purchasing Division. (This bulletin covers only one aspect of safe practices with compressed gas.)

* 3-7-60 OSC

III-3 ELECTRICITY*

Electric current can be sensed at levels far below those which cause burns or other damage to the body, and the startling effect of electric shock at very low levels of current may lead to injury. Although no damage is caused to the body by current slightly above the threshold of perception, the light shock produced may be sufficiently disturbing to lead to dropping a power tool or losing one's footing on a ladder, or in some other way producing an accident or injury.

Experimental results obtained on 114 men holding small copper wires loosely in their hands with 60-cycle alternating current applied indicate a threshold of perception at 1.0 milliampere. This is the response for 50 per cent of the group. Industrial experience has shown that if the current is limited to 0.3 milliampere, the chance of shock sensation is small.

For direct current the threshold of perception is about 5 milliamperes, which is five times higher than that obtained on commercial 60-cycle alternating current.

With gradually increasing alternating currents, the first sensations of tingling give way to contractions of the muscles. Sensations of heat and muscular contractions increase as the current is increased; sensations of pain develop, and finally the current is such that a person cannot release his grasp of the conductor. At this point the victim is said to "freeze" to the circuit, and if long continued, collapse, unconsciousness, and death result.

Alternating currents in excess of about 25 milliamperes are very painful, and when the current pathway is across the chest the muscular reactions become so severe that breathing is difficult, if not impossible, for the duration of the shock. Death may result from asphyxiation if the current persists for more than a few minutes. However, if the current is interrupted in a reasonable time, breathing resumes automatically and no serious aftereffects result.

Currents in excess of 100 milliamperes, if they take a pathway through the body in the region of the heart, may affect the heart, causing what is called ventricular fibrillation. Ventricular fibrillation is nearly always fatal and is commonly called instantaneous electrocution. When the ventricles of the heart are in fibrillation, the circulation of the blood ceases and death shortly ensues.

Although there is no known cure for ventricular fibrillation, it is believed that abdominal massage and accompanying stimulation of the heart caused by the

* 3-22-61 OSC

application of artificial respiration may be beneficial in assisting the heart to regain its normal rhythm. Since it is impossible for the layman to distinguish between respiratory inhibition, ventricular fibrillation, and heart failure, he should begin artificial respiration immediately upon rescue of the victim from the circuit. Do not touch a victim in contact with electrified circuit but rescue the person by using a dry clean rope or a dry unpainted pole. Keep as far away as possible. If possible, shut off current by throwing the nearest switch.

It is very important that resuscitation be continued without interruption, because if the supply of oxygen to the brain is cut off for more than a few minutes, serious permanent injury to the brain is likely to result even though the victim should recover. The victim should be kept warm and a physician brought to the scene as soon as possible. Artificial respiration should be continued until the victim recovers, or rigor mortis sets in, or a physician pronounces him dead.

Relatively large currents, amperes and not milliamperes, may cause death by overheating the body. Delayed death may be caused by hemorrhages, severe burns, or other serious aftereffects. Death may result also from a combination of the causes just mentioned, or from complications incidental to electric shock such as injury by a fall.

EFFECTS OF ELECTRICAL CURRENT ON THE HUMAN BODY*

	Readings	*Effects*
Safe Current Values	1** Milliampere or Less	Causes No Sensation — Not Felt
	1 to 8 mA	Sensation of shock, not painful; individual can let go at will, as muscular control is not lost.
Unsafe Current Values	8 to 15 mA	Painful shock, individual can let go at will as muscular control is not lost.
	15 to 20 mA	Painful shock, muscular control of adjacent muscles lost. Cannot let go.
	20 to 50 mA	Painful, severe muscular contractions, breathing is difficult.
	50 to 100 mA (possible) 100 to 200 mA (certain)	Ventricular fibrillation (a heart condition that nearly always results in death).
	200 mA and over	Severe burns, severe muscular contractions, so severe that chest muscles clamp heart and stop it during duration of shock. (This prevents ventricular fibrillation.)

* Adapted from *Accident Prevention Manual for Industrial Operations*, 4th Ed., 1959, National Safety Council.
** 1 Milliampere is 1/1000 of an ampere.

The most important variable in electric shock is the current itself. The current (or amperage) is not entirely dependent on the voltage but depends also on the resistance of the shock circuit through the body including both body contacts. The body resistance can be determined and it varies as per table:

HUMAN RESISTANCE TO ELECTRICAL CURRENT

Type of Resistance	*Resistance Value*
Dry skin	100,000 to 600,000 Ohms
Wet skin	1,000 Ohms
Internal body — hand to foot	400 to 600 Ohms
Ear to ear	About 100 Ohms

Ohms' Law expresses the quantitative relation between these factors of voltage, current, and resistance for electric circuits in general. To determine the severity of a shock, the formula can be used as follows:

$$\text{current through body} = \frac{\text{voltage applied to body}}{\text{resistance of body and contacts}}$$

Under certain conditions providing low resistance to passage of current (wet skin contact, for example) voltages of 45 to 60 have proved fatal. Any voltage above 32 is dangerous. The danger to the person is measured by voltage in relation to resistance of the body to the passage of current. This is why it is so dangerous to use a portable electric power tool (110 volts) without a grounding wire, particularly in a damp location or where other good paths of current to ground are provided.

SUMMARY

(1) The harmless shock from a very small current may startle a person in such a way as to cause an accident or injury.

(2) Currents under 1.0 milliampere, alternating current, are hardly perceptible.

(3) Currents over 25 mA, AC, are painful.

(4) Currents between 100 and 200 mA, AC, produce ventricular fibrillation and cause death more frequently than heavier currents.

(5) Any voltage above 32 is dangerous.

Reference: Charles F. Dalziel, "Scientific Facts Concerning Electrical Hazards," *National Safety News,* Oct. 1947.

III-4 INCOMPATIBLE CHEMICALS†

Many so-called accidents in laboratories are simple unanticipated reactions of incompatible materials. A number of such incompatible materials are listed in opposite columns below. Some combinations produce vigorous, violent, or explosive reactions at room temperature. Others may require heat or pressure to react violently. When in doubt, check on the experience of others, look into the literature, proceed with caution, experiment with small quantities. Most important, protect yourself with fixed shielding, safety eyeshield or face shield. Finally, don't consider this list complete.

Alkali Metals (Na, K, etc.) Al and Mg powder	H_2O, organic halides (e.g., CCl_4), CO_2, acids
Ammonia (anhydrous)	Halogens, mineral acids, mercury, silver nitrate
Aniline	Nitric acid, hydrogen peroxide, nitric oxide
Bromine	Ammonia, hydrogen, petroleum gases, metal powders
Chlorine	Same as bromine
Chromic Acid	Acetic anhydride,* ethyl acetate,* isoamyl alcohol,* benzaldehyde,* n-butyl alcohol,** Carbitol,** Cellosolve,** camphor,** di-isopropyl ether,** ethylene glycol,** furfural,** glycerol,** methanol
Hydrogen Peroxide	Most metal powders and their salts, flammable liquids, aniline, nitromethane
Mercury	Ammonia
Metal Hydrides	Water, acids
Nitric Acid (conc)	Aniline, hydrogen sulfide, flammable liquids, gases, and hydrazine
Oxidizers perchlorates, peroxides, permanganates, persulfates, perborates, nitrates, halogens, chlorates, chlorites, bromates, iodates, conc sulfuric, and conc nitric acids	Most metal powders, ammonium salts, phosphorus, finely divided organics (e.g., sugar), combustible liquids, acids, sulfur
Perchloric Acid	Drying agents (e.g., H_2SO_4 and acetic anhydride), bismuth compounds

* More violent than 0.5 gms K Mn O_4 + 0.5 cc glycerin. "Some Studies in Chemical Fire Hazards" by Douglas and Thompson in *Oklahoma Engineering Experiment Station Publication* No. 73 dated November 1949.
** Standard violence as described in (*) above.
† 11-15-60 OSC

Sodium Peroxide	Same as for oxidizers, glacial acetic,* acetic anhydride,* benzaldehyde,* CS_2, Carbitol,* Cellosolve,* creosote,* ethyl acetate,* ethylene glycol,* furfural,* glycerol*
Water	Alkali metals, acetyl bromide, acetyl chloride, benzoyl chloride, boron hydride, calcium, barium peroxide, conc H_2SO_4, solid Na and K hydroxides, sodium amide, phosphorus oxychloride, phosphorus trichloride, phosphoric anhydride, sulfuryl chloride, thionyl chloride, chlorosulfonic acid, metal hydrides

* More violent than 0.5 gms K Mn O_4 + 0.5 cc glycerin.

References: Dangerous Chemical Code, 1951, compiled by the Bureau of Fire Prevention, City of Los Angeles Fire Department; Laboratory Hazards Bulletin, Plant Safety Br., National Institutes of Health, October, 1960. Reviewed and expanded by Chemistry Safety Committee, University of Illinois.

III-5 LABORATORY VENTILATION*

Of all environmental factors, the air we breathe is the most important to health, comfort, and safety. This is particularly true in laboratories, shops, and research facilities of the University, where a variety of dusts, fumes, vapors, mists, and odors are every day produced in programs of instruction and research. Unless these contaminants in the work atmosphere are diluted or entirely removed by good ventilation procedures, students and researchers are continually forced to breathe impurities which may be highly toxic, and explosive vapors may be permitted to collect.

Older buildings tend to have bad air problems in that expansion of ventilation systems has not kept pace with the expansion of operations demanding mechanical ventilation. These are some of the main difficulties:

(1) Odors appearing in one laboratory and known to originate in another.

(2) Fumes drawn out of a hood into the laboratory by cross currents or by the pull of other fume hoods, through lack of sufficient makeup air.

(3) Fumes pulled out of fume hoods by window fans.

(4) Fume hoods used unnecessarily for storage of materials.

(5) Ventilating ducts thick with dust, rendering the duct a fire and explosion hazard and reducing greatly the efficiency of the duct.

(6) Exhaust fans and fume hood exhaust systems operating against each other and without sufficient makeup air, resulting in stagnation.

(7) Makeup air taken from stairways and corridors which in turn draw contaminated air from other laboratories and reduce the efficiency of ventilation in those laboratories.

Without careful preplanning and continuing attention to the total demands of exhaust systems for makeup air, exhaust hoods and exhaust ducts may be provided to remove air from problem areas without a corresponding increase in makeup air. By opening all doors and some windows, we satisfy the demands of fans and blowers.

The problems are less acute during the summer when windows and doors are open. In the fall and winter, doors and windows are closed to maintain comfort in the building, and fans begin laboring to draw air from rooms where no air is supplied — whole laboratories then operate under a negative pressure. The result is stagnation, and the poorest work atmosphere.

* 1-21-63 OSC

Checklist of ventilation principles:

(1) Provide sufficient makeup air to satisfy the demands of every mechanical exhaust facility.

(2) Don't depend on corridors and stairways for makeup air.

(3) Remember that under normal circumstances the air closest to the exhaust fan is the stalest and most contaminated; the air nearest the window or other point of entry into the building should be the cleanest unless contaminated by effluent from other exhaust points.

(4) No hood should be installed without adequate consideration for makeup air.

(5) Storage in hoods should be held to the minimum.

(6) Hoods and duct systems should have periodic maintenance to insure efficient removal of contaminants and safety against fire and explosion.

III-6 MERCURY*

Mercury has properties which make it invaluable in the laboratory. Because it is highly toxic when absorbed into the body, and under extreme circumstances may cause death, it is important to take sensible precautions in using it. One of the most important of these is the painstaking cleanup of mercury spills.

HEALTH HAZARD

The American Standards Association lists the maximum acceptable concentration of mercury in air at 0.1 milligram per cubic meter or 0.01 parts per million by volume for an eight-hour day, five-day week lifetime exposure. There is little factor of safety, however, as concentrations only two to three times greater often result in symptoms of mercury poisoning.

Absorption into the body occurs by inhalation, by ingestion, or through the skin. A large portion of absorbed mercury is excreted by the body. When the amount absorbed is excessive, sufficient mercury is retained to produce the ill effects of systemic poisoning and emotional disturbances.

VAPOR CONCENTRATIONS

Any process involving the heating of mercury in any way can result in an overwhelming concentration of vapor in the experimenter's breathing zone almost immediately. The rate of volatilization of mercury at any temperature varies proportionately with the surface exposed. Clean mercury, for example, is readily divided into globules, but these globules coalesce when brought together again. On the other hand, mercury soiled by grease and dust will divide into minute globules which do not coalesce. These dusty and greasy particles can become so minute that they may not be seen by the naked eye and may simply assume the appearance of a dirty surface. Under the feet of occupants of the room or when disturbed by activities around the work bench, it becomes finely divided into dirty, minute particles which may be forced into cracks or rough surfaces. In this manner, a comparatively small amount of mercury in an almost invisible state of subdivision presents an exposed surface which gives off toxic vapors equivalent to those produced by a large mass of mercury in a dish or pan.

SPILLED MERCURY PICKUP

Spilled mercury should therefore be picked up immediately. Scrubbing contaminated surfaces with adequate amounts of soap and water, followed by

* 10-4-62 OSC

rinsing with copious amounts of water, has been shown to be most effective in reducing mercury contamination. While dry sweeping is discouraged because of the dust and vapor it tends to throw into the air, careful sweeping, after large particles have been picked up with an aspirator or vacuum, and using activated alumina or sulfur as a sweeping compound, appears to be a safe and practical method.

A special vacuum sweeper for mercury cleanup operations is available (Champaign-Urbana) on a lend basis from the Safety Coordinator's office, and arrangements can be made through that office also for determinations of mercury vapor contamination.

III-7 PERCHLORIC ACID ($HClO_4$)*

Four incidents involving perchloric acid, all of which occurred in University of Illinois laboratories, demonstrate the need for intelligent caution in dealing with this useful yet potentially dangerous substance.

(1) A stone table of a hood was patched with a cement made up with glycerin. Several years later the hood was being removed and the table exploded when a workman struck a chisel with a hammer in breaking up the table. The hood had been used for digestions with perchloric acid. Presumably, the acid spilled on the patched table over the years and was not properly cleaned.

(2) A six pound bottle of perchloric acid broke and ran over a fairly large area of a wooden laboratory floor. It was cleaned up soon but some ran down over the wooden joists. Several years passed without incident. Then, one day a bottle of sulfuric acid was spilled in almost the same location. A fire broke out almost immediately in the floor and the joists.

(3) A chemist reached for a bottle of perchloric acid stored on a window sill above a steam radiator. The bottle struck the radiator, broke and the acid flowed over the hot coils. In a few minutes the floor beneath the radiator burst into flame.

(4) Until about 2½ years ago a conventional hood was used for perchloric acid digestions. During and since that time the same hood was used for other chemical reactions plus distillation and ashing of organic materials. Hot gas sent up the 12-inch tubular transite exhaust duct during a recent ashing procedure apparently set off one or a series of explosions that tore the ducts apart at severe angles and at horizontal runs.

HAZARDS

(1) Use of hot acid or concentrations above 72 per cent add greatly to the hazard. Sulfuric acid mixed with perchloric acid generates stronger perchloric acid up to and including anhydrous acid. This strength of acid (90–100 per cent) is very hazardous and may explode spontaneously.

(2) Contact of perchloric acid with oxidizable or combustible materials or with dehydrating or reducing agents may result in fire or explosion.

(3) Combustible material which has been soaked with aqueous perchloric acid and dried may be ignited by impact, friction, or moderate heat.

(4) Reaction with metallic bismuth produces a spontaneously explosive compound.

* 3-15-62 OSC

SAFE PROCEDURES

(1) In wet combustions with $HClO_4$ treat the sample first with HNO_3, to destroy easily oxidizable organic matter.

(2) Contact of $HClO_4$ solutions with strong dehydrating agents such as P_2O_5 or concentrated H_2SO_4 may result in formation of explosive anhydrous $HClO_4$. Exercise special care in performing analyses requiring the use of $HClO_4$ with such agents.

SPILLS

(1) Remove spilled $HClO_4$ by immediate and thorough washing with large quantities of water.

HOODS AND DUCTS

(1) Fuming should be carried on in noncombustible hoods constructed of metal or stoneware, and left unpainted or protected with an inorganic coating such as porcelain. Silicate of soda and alundum cement should be used for joining parts in hood construction rather than litharge and glycerin cement.

(2) A water spray is desirable for washing down the hood after perchloric acid fuming. Otherwise, a separate hood should be reserved for perchloric acid use only. Water wash hoods are available commercially.

(3) Ducts should take the shortest path to the outdoors. Ducts must not be manifolded. Vibration connections in ducts should be of an inorganic material such as fiber glass cloth.

(4) Use an electric hot plate or heating jacket, a steam bath, or an electrically or steam-heated sand bath for heating reaction vessels. Do not use gas flames or oil baths for heating.

(5) Provide a generous supply of water extinguishers.

PERSONAL PROTECTIVE EQUIPMENT

(1) Persons handling perchloric acid should be provided with, and required to use, gloves, sleeves, aprons and boots of rubber; and shields or goggles for face protection. If acid does get on the person the area should be washed with generous amounts of water.

STORAGE

(1) Confine the amount of perchloric acid in the working area to the quantity needed for current work. Several 1-lb. bottles or two 7-lb. bottles are the maximum amount of storage advisable in a laboratory building. One half liquid ounce of perchloric acid is usually sufficient for a single analysis. Each bottle

used for current work should be kept in a glass or ceramic dish large enough to hold the contents of the bottle. Bottles not in active use should be isolated in noncombustible cabinets away from combustible materials and chemicals.

(2) Store carboys preferably on a raised steel rack mounted on an acid-resisting brick, concrete treated with sodium silicate, or steel floor. Provide drainage facilities and hose for diluting leakage or spills. However, bulk storage for University usage should be limited to 7-lb. bottles and use of carboys restricted.

(3) Bulk storage should be examined periodically, and acid that has become contaminated and discolored should be disposed of as follows: pour the contaminated acid into approximately 10 times its volume of cold water in a porcelain or glass vessel. Stir and pour down the acid sewer. Follow this by flushing with large quantities of water.

Information in this report has been obtained from:

G. Frederick Smith, Professor of Analytical Chemistry, Emeritus, University of Illinois

Factory Mutual Engineering Division of Associated Factory Mutual Fire Insurance Companies

National Safety Council — Data Sheet D-311 Perchloric Acid

Committee on Use of Perchloric Acid in Methods of Analysis, Association of Official Agricultural Chemists

III-8 SAFETY SHOWERS*

Safety showers are needed in certain laboratories to provide immediate emergency protection for persons against injury from fire or corrosive substances. Minimum safety shower standards recommended for the University are as follows:

(1) Emergency showers should be located in each laboratory area where the hazards of injury through contact with fire or corrosive substances are present.

(2) Student organic chemistry laboratories should have safety showers at a ratio of one shower for every six students, except that under the most favorable scheme of distribution and in laboratories of superior plan, the ratio may be figured at one shower for every eight or ten students.

(3) Research laboratories should have one shower for every four researchers; laboratories smaller than this may have showers located outside the door and serving more than one such laboratory if the plan of the building and the rooms permits. This is not as desirable, however, as having the shower in the laboratory individually.

(4) Showers should be installed near principal exits; additional required showers should be placed in central and easily accessible locations.

(5) The safety shower should deliver thirty gallons per minute in a gentle flood of water so as to reduce the likelihood of further injury which might be caused by a more powerful spray.

(6) If the control valve is operated by a chain, the chain should extend almost to the floor and be fastened to the wall so that a large loop is formed, since this arrangement meets all requirements for emergency use better than others.

(7) Eye irrigators, foot-operated or brow-operated, should be installed also as special eye protection in laboratories where there is frequent or daily exposure to the splashing of injurious substances into the eyes. These can usually be installed at the end of a laboratory bench.

* 1960 OSC (Chem. Safety Committee, Urbana)

III-9 ORGANIZATION FOR SAFETY*

Recommendation of University policy in safety is the joint responsibility of the Safety and Fire Prevention Committee and the Safety Coordinator. Before being presented to the administration for endorsement as University policy, a statement is subjected to discussion in the committee and is then sent out for review to interested faculty members and administrators outside the committee.

THE SAFETY COORDINATOR

The continuing safety program of the University is a responsibility of the Safety Coordinator, under the direction of Vice-President and Comptroller H. O. Farber. The staff consists of Safety Coordinator John Morris, Field Safety Officer John C. Martin, Safety Inspector Charles B. Wingstrom, and Fire Inspection Officer Robert G. Jessup. The central safety assignment at Chicago is that of Ray Ketchmark, Safety Officer in the Office of Vice-President N. A. Parker, Chicago Circle. Mr. Ketchmark has similar responsibilities also at the Medical Center, reporting there to Vice-President J. S. Begando, pending establishment on that campus of a safety post in the central administration. The Safety Coordinator is executive secretary to the Safety and Fire Prevention Committee and serves also as consultant to top level administration in Chicago.

The safety assignment includes:

(1) Recommendation of codes and standards, and the interpretation of standards in University operations.

(2) Consultation with faculty and staff persons in matters of safety.

(3) Cooperation with committees concerned with matters of safety.

(4) Problem-solving services.

(5) Investigation of injuries and accidents with a view toward improvement of methods and equipment and removal of hazards.

(6) Review of plans for new construction and building alterations for points of safety and fire safety.

(7) Maintenance of a complete library of technical literature.

(8) Liaison with state and local safety and fire prevention authorities.

(9) Inspection services related to safety and fire prevention.

THE SAFETY AND FIRE PREVENTION COMMITTEE

The Safety and Fire Prevention Committee, appointed annually by the President, serves to counsel and support the Safety Coordinator and assist in the development of safety policy and programs of safety. The committee meets six or

* Revised 10-15-64 SFP

more times during the year. In addition to representing all three major locations of the University, the committee members combine the disciplines of civil and mechanical engineering, personnel administration, agriculture, medicine, law, chemistry, physics, architecture, sanitary engineering, fire protection, occupational safety, and industrial administration. Former members of the committee include L. L. Fatherree, George T. Frampton, Charles H. Bowman, John P. Hummel, Eric Baer, Peter Beak, M. D. Kinzie, Donald Dickason, and Wallace W. Sanders, Jr. Members who have served with distinction as chairmen have been Julian Fellows, 1955-59, and Ernst R. Kirch, 1960-64.

Appointed to serve until August 31, 1965

John W. Briscoe, Civil Engineering (Chairman)
W. D. Compton, Physics
E. Joe DeMaris, Accountancy
Eugene Chesson, Jr., Civil Engineering

Appointed to serve until August 31, 1966

C. H. Farnham, Agronomy
E. R. Kirch, Pharmacy, Medical Center
H. L. Mikolajczyk, Architecture, Chicago Circle
H. L. White, Physical Plant

Ex Officio

L. M. Hursh, M.D., Health Service
Ray Ketchmark, Safety Officer, Chicago Circle
Arlyn C. Marks, Director, Nonacademic Personnel
John Morris, Safety Coordinator
E. L. Palmberg, Office of the Legal Counsel

Advisors

A. E. Florio, Health and Safety Education
G. W. Harper, Mechanical Engineering
*R. G. Jessup, Fire Inspection Officer
*Henry Koertge, Sanitary Engineer
*J. C. Martin, Field Safety Officer
*C. B. Wingstrom, Safety Inspector

ENVIRONMENTAL HEALTH

Activities in certain areas of environmental hazard control at Champaign-Urbana are assigned to the Division of Environmental Health in the Health Service, and include programs of sanitation and environmental health in water supplies, swimming pools, sewers and sewage, food services on and off campus, air pollution, production of dairy products, and review of plans for new buildings and alterations for health hazards. The Division is staffed by Laurence M. Hursh, M.D., Henry Koertge, Sanitary Engineer, and a full-time sanitarian.

* Technical advisors appointed by the Chairman

RADIATION SAFETY

Control of radiation hazards at the various campuses of the University is assigned as follows: at Champaign-Urbana, to Health Physicist JEROME J. STEERMAN in the Graduate College; at the Medical Center to R. A. HARVEY, M.D., Radiologist in Chief, Research and Educational Hospitals, and WALTER S. MOOS, Resident Professor of Radiology and Radiation Physicist; at Chicago Circle to LOUIS CHANDLER, Physics Department. At each campus the radiation protection program is under the supervisory control of a radiation hazards advisory committee established under procedures recommended by the Atomic Energy Commission.

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